

MICHAEL MÄKER  
GÜNTER VOGT  
RAINER OHLINGER

5                    METHOD FOR PRODUCING AN EMBOSSING ROLLER FROM  
                    SILICONE RUBBER FOR THE CONTINUOUS EMBOSSING OF THE  
                    SURFACE OF A THERMOPLASTIC FILM

CROSS REFERENCE TO RELATED APPLICATIONS

10                   This application claims the priority of German Application No.  
                    101 10 922.9, filed March 7, 2001, which is incorporated herein by  
                    reference.

FIELD OF THE INVENTION

15                   The invention relates to a method of the type described in the  
                    preamble of Claim 1 for producing an embossing roller for the  
                    continuous embossing of the surface of a thermoplastic film.

## BACKGROUND OF THE INVENTION

5 A method for producing an embossing roller for the continuous embossing of the surface of a thermoplastic film is known from German Patent 34 05 985 C2, in which the surface structure is derived from a natural grain pattern by means of multiple casting processes. Although this known method leads to the desired result of producing a silicone embossing roller with a continuous surface structure, a significant disadvantage of this known method is the high cost of carrying out the intermediate steps to create the surface structure.

10 A method of the type described in the preamble of Claim 1 is known from German Patent 44 41 216 C2, in which the embossing structure in the embossing surface of an embossing roller made of silicone rubber is created directly by laser beam processing, and the embossing roller is moved, in a location- and surface-dependent manner that is generally known, corresponding to the surface structure of a pattern. This known method also achieves high pattern fidelity, especially for very fine surface structures. An advantage of this known teaching is that the embossing surface of the embossing roller is created directly without any intermediate steps. This results in considerable time savings as well as the option of producing a large variety of different surface structures in comparison to the known method previously described. A disadvantage is that the silicone rubber rollers are very sensitive and susceptible to damage, with the result that after a certain embossing and operating time the existing embossing roller must be replaced by a new embossing roller, which in turn requires

complicated processing of the embossing surface, using a laser beam.

#### OBJECTS AND SUMMARY OF THE INVENTION

5 An object of the invention is to modify a method of the type described in the preamble of Claim 1 to simplify the production of a plurality of embossing rollers for exchange with used embossing rollers.

That object of the invention is achieved by the teaching described in the body of Claim 1.

#### DETAILED DESCRIPTION OF THE INVENTION

10 The invention relates to a method for producing an embossing roller from silicone rubber for the continuous embossing of the surface of a thermoplastic film, with the embossing surface having a negative form of a surface structure to be embossed, in particular a grain. First an auxiliary roller is produced which is made of plastic, at least in the region of its circumferential surface. A laser beam is directed onto the smooth circumferential surface in such a way that said laser beam moves relative to the circumferential surface. In addition, the laser beam is controlled so as to be congruent with the particular site on the surface structure of a real pattern or of an imaginary pattern which is present in the form of data, in such a way that the surface

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structure of the pattern is created as a positive form in the circumferential surface. A layer of silicone rubber of uniform thickness is poured or spread onto this circumferential surface of the auxiliary roller and vulcanized to produce an embossing matrix which is pulled off the circumferential surface, turned inside out, and adhered to a circumferential surface of an embossing roller, with the negatively structured embossing surface facing outward. The method enables embossing matrices to be created several times after a one-time structuring of the surface of an auxiliary roller, using a simple, time-saving, and economical casting process.

The basic concept of the invention is to modify the known method for structuring the surface of a roller, relying on a pattern, in such a way that the embossing surface is duplicated not by laser processing, but instead by a casting process. Embossing rollers produced using this casting process create surfaces on thermoplastic films whose surface quality is equivalent to that obtainable via the state-of-the-art method according to the aforementioned German Patent 44 41 216 C2.

That casting process is made possible by using an auxiliary roller in whose smooth surface the embossing structure is created not in the negative form, as in the previously described known method, but rather in the positive form.

Thus, it is possible to directly create an embossing surface in silicone rubber by casting from the surface of the auxiliary roller. To this end, a layer of silicone rubber of uniform thickness is poured or spread onto the surface of the auxiliary roller having a positive embossing structure and vulcanized to

produce an embossing matrix in such a way that an embossing surface with a negative structure is formed in said embossing matrix. After vulcanization, the tubular embossing matrix is turned inside out and adhered to a circumferential surface of an embossing roller, with the negatively structured embossing surface facing outward. That embossing roller can then be used directly for the continuous embossing of the surface of a thermoplastic surface.

A large number of embossing matrices may be created from the positively structured surface of the auxiliary roller. Because this casting process is simple and does not require much time, it is not absolutely necessary to have several replacement embossing rollers on hand. If needed, an embossing matrix can always be quickly created and adhered to an embossing roller.

Of course, it is important that the embossing matrix made of silicone rubber be pulled off the surface of the auxiliary roller after vulcanization. For this reason, silicone rubber is less suitable than plastic in the region of the circumferential surface of the auxiliary roller because separating means can damage the fine structure of the embossing surface.

A development of the invention therefore provides for the plastic in the region of the surface of the auxiliary roller to be disposed in such a way that the silicone rubber poured or spread onto this surface may be separated from the surface of the auxiliary roller after vulcanization. The plastic in the region of the circumferential surface of the auxiliary roller is preferably nitrile butadiene rubber. The method according to the invention is applicable not only to an embossing roller, but in a similar

fashion is also applicable to an embossing stamp for the discontinuous embossing of the surface of a thermoplastic film.

The control signal for the laser may be obtained either by scanning a surface structure that is physically present, such as a leather pattern, or from digitally created data fields. In each case the control signal may be processed, for example, by defamiliarization, before sending to the laser.

### Example

A layer of nitrile butadiene rubber was first applied to an auxiliary roller, preferably made of steel, having a smooth circumferential surface. The auxiliary roller was rotated, and a laser beam was led parallel to the rotational axis of the auxiliary roller over the circumferential surface thereof in such a way that essentially the entire circumferential surface was coated. During this movement of the laser beam relative to the surface of the auxiliary roller, the intensity of the laser beam was regulated as a function of a control signal obtained by scanning the surface of a pattern. The surface was scanned optically or mechanically, and an electrical signal corresponding to this scanning was generated which was directly used for controlling the laser. The polarity of the electrical signal was such that the embossing structure created in the surface of the auxiliary roller was a positive form of the surface structure of the desired surface structure to be created.

After the entire surface of the auxiliary roller was provided with a positive embossing structure in this manner, a layer of

silicone rubber of uniform thickness was poured or applied thereto, and said surface was then cured or crosslinked to produce an embossing matrix. This embossing matrix was pulled from the surface of the auxiliary roller and then turned inside out and adhered to the circumferential surface of an embossing roller, with its negatively structured embossing surface facing outward. The embossing roller could then be used directly to emboss a thermoplastic surface under heat and pressure.

While this invention has been described as having a preferred design, it is understood that it is capable of further modifications, and uses and/or adaptations of the invention and following in general the principle of the invention and including such departures from the present disclosure as come within the known or customary practice in the art to which the invention pertains, and as may be applied to the central features hereinbefore set forth, and fall within the scope of the invention or limits of the claims appended hereto.